

THE HOMOLOGY AND INNERVATION OF THE ACHSELBOGEN AND PECTORALIS QUARTUS, AND THE NATURE OF THE LATERAL CUTANEOUS NERVE OF THE THORAX. By AMBROSE BIRMINGHAM, M.B., *Professor of Anatomy, Catholic University, Ireland.*¹

THERE are occasionally found in the region of the shoulder in man two inconstant muscles, the true nature of which, judging by the views of different anatomists on the subject, is not quite settled. The muscles I refer to are the achselbogen of Langer, more commonly known as a muscular axillary arch, and the pectoralis quartus. The first (found once in every sixteen subjects, according to Professor Macalister,² or in 7 per cent. of the bodies examined, according to Krause³) is a narrow band, generally muscular, passing from the posterior to the anterior fold of the axilla. The second is a rare muscle in the human subject, but is commonly found in animals; it runs along, or under cover of the lower margin of the pectoralis major, from the thorax to the upper part of the arm.

With regard to the achselbogen, the following views have been put forward:—(1) Mr Galton⁴ considered it the representative in the human subject of the pectoralis quartus in animals, a view supported by Professor Macalister.⁵ (2) Mr J. B. Perrin⁶ is of opinion that the achselbogen is an “aborted variety of the dorso-epitrochlearis,” which latter he regards as an “aborted specimen of the panniculus,” or a “representative of the dorso-humeral portion of the panniculus.” (3) According to Professor Humphry,⁷ the achselbogen is due to the imperfect segmentation of the pectoralis major from the latissimus dorsi, or of the ventral from the dorsal portion of the superficial brachio-cephalic muscular sheet, being as it were a partial reversion to the condition in *Lepidosiren*, where the two muscles are continuous with each other. And, lastly, there is the

¹ This paper was read before the Anatomical Section of the Royal Academy of Medicine, Ireland, in March 1888.

² *Trans. Roy. Irish Acad.*, 1872.

³ Quoted by Mr J. T. Wilson, *Jour. Anat.*, vol. xxii.

⁴ *Linn. Trans.*, vol. xxi.

⁵ *Ann. and Mag. Nat. Hist.*, July 1869.

⁶ Mr Wilson, *Jour. Anat.*, vol. xxii.

⁷ *Observations in Myology*, p. 131.

view suggested by Sir William Turner,¹ and supported by Mr J. T. Wilson,² that the achselbogen is a representative of the panniculus. As to the pectoralis quartus, it was considered by Mr Galton, as mentioned above, to correspond to the achselbogen. Mr Wood³ suggested that it was an imperfectly developed slip of the dorso-epitrochlearis. Professor Owen⁴ regarded it as a differentiated portion of the great pectoral, and Professor Macalister,⁵ in confirmation of this view, says,—“This muscle I consider to be a fourth pectoral, and its insertion is, I think, sufficient to determine this relation.” Lastly, Professor Humphry⁶ describes a muscle, which he calls the brachio-lateralis, as a portion of the panniculus, but the brachio-lateralis of Professor Humphry is the pectoralis quartus of other authors (according to Professor Macalister),⁷ therefore we may infer that Professor Humphry considers the pectoralis quartus a derivative of the panniculus. In the “Challenger Reports”⁸ Professor Cunningham expresses a similar passing opinion.

Thus we see there are four different views held by anatomists regarding each of the muscles under consideration: to solve the question, which are we to adopt? I propose to examine the different theories *seriatim*, testing each, when necessary, by the following criteria of homology, position, origin, insertion, and, most important, nerve-supply.

First, I shall take up the pectoralis quartus. Professor Macalister, in his “Muscular Anomalies,”⁹ describes the pectoralis quartus as a muscle rarely present in man, which, arising from the lower ribs and lateral thoracic fascia, runs along the lower margin of the great pectoral, and is inserted into the humerus with or below the pectoralis major, or into the fascia of the upper part of the arm alone. Its nerve in man comes from the internal anterior thoracic (Dr Brooks kindly supplied me with notes of some dissections, in which he found the nerve thus derived). Dr W. H. Thompson has found in the Sloth Bear, and I in the Dog, Cat, Macaque Monkey, and Man, the muscle supplied by the same nerve. The first theory I have mentioned with regard to the homology of this muscle is Mr Galton's, namely,

¹ *Jour. Anat.*, vol. i., footnote p. 252, 1867.

² Mr Wilson, *Jour. Anat.*, vol. xxii., 1888.

³ Macalister, *Ann. Nat. Hist.*, July 1869.

⁴ *Ibid.*

⁵ *Ibid.*

⁶ *Observations in Myology*, p. 132.

⁷ *Ann. Nat. Hist.*, March 1870.

⁸ Vol. v. part xvi., 1882.

⁹ *Trans. Roy. Irish Acad.*, 1872.

that the pectoralis quartus corresponds to the achselbogen. That this is not so is proven at once, I think, by the fact that in two cases—the notes of which Dr Brooks has kindly sent and me—the pectoralis quartus and achselbogen were both present, and each occupied its usual position; further, at its pectoral end the achselbogen was connected with the pectoralis quartus instead of with the great pectoral as usual. Later on, when we find the true nature of the achselbogen, other reasons for opposing Mr Galton's view will become apparent.

Next comes Mr Wood's idea that the pectoralis quartus is an imperfectly-developed slip of the dorso-epitrochlearis. That this is not correct, Mr Galton argues, from the fact that the dorso-epitrochlearis and pectoralis quartus are both present, and distinct in many animals, and his argument is supported by Professor Macalister.¹ The dorso-epitrochlearis usually springs from the latissimus dorsi at the junction of tendon and muscle, passes down the inner side of the arm, and is inserted in the region of the inner condyle or olecranon. At once we see it does not correspond with the pectoralis quartus in origin, insertion, or position. The same may be said with regard to nerve-supply. In the Chimpanzee the dorso-epitrochlearis is supplied by the musculo-spinal nerve, according to Mr Champneys,² and I have found it supplied virtually by the same nerve in the Macaque, Dog, and Cat. Hence we see that in nerve-supply, as well as in the other criteria proposed, the dorso-epitrochlearis and pectoralis quartus disagree, and they evidently are not homologues.

Lastly, we have the views of Professor Owen and Professor Humphry; the former considers the muscle a differentiated portion of the lower border of the great pectoral, and, with such a segmented slip, it agrees in origin, position, insertion, and nerve-supply; it corresponds in every detail with the lower border of the pectoral. On the other hand, testing Professor Humphry's view,—that the quartus is derived from the ventral part of the humeral panniculus,—we find that the pectoralis quartus agrees with this portion of the panniculus in position, insertion, and indeed, we might add, in origin, for a thickened band of the panniculus is found in many animals—for instance

¹ *Ann. Nat. Hist.*, 1869.

² *Jour. Anat.*, vol. vi. p. 180, *footnote*.

the Rabbit—running along the axillary margin of the pectoralis major from the ventral aspect of the thorax and abdomen to the arm, and this band looks remarkably like a pectoralis quartus. But in nerve-supply there is an apparent difference: the panniculus is supplied by the “lateral cutaneous nerve of the thorax,”¹ which is said by Dr A. M. Paterson² to be the homologue of the nerve of Wrisberg, the quartus by the internal anterior thoracic; these statements weigh heavily against Professor Humphry’s theory if they be accurate, but I hope to be able to show later on, in connection with the achselbogen and its nerve-supply, that this difference in innervation is little more than apparent. For the present, then, we may consider that both views present nearly equal claims for adoption on the grounds of position, origin, insertion, and nerve-supply. The following considerations may help us to decide which is the correct view to be taken:—(1) In the Kangaroo and Wallaby the pectoralis quartus is very large, its ventral fibres blend with the pectoralis major, and its dorsal fibres with the latissimus dorsi, while it is covered superficially by the panniculus: here evidently the muscle is derived from the same sheet as the pectoralis major and latissimus; it fills the entire interval between the two, and, remembering that it is covered on its surface by the panniculus, we must consider that this condition militates strongly against the idea that the quartus is panniculus. (2) In two cases of Dr Brooks the achselbogen was attached to the pectoralis quartus instead of to the lower border of the great pectoral: here the quartus evidently took the place of part of the major. This also favours Professor Owen’s view. And, lastly, the condition which is found in the Cat would seem to show that it is apparently impossible that the pectoralis quartus could be derived from the panniculus. In this animal, except with great care, it is very difficult to accurately separate the panniculus from the underlying muscles, particularly from the axillary borders of the pectoralis major and latissimus dorsi; but if it be first raised on the dorsal aspect of the trunk, and then carefully dissected towards the axilla, the

¹ The subcutaneous thoracic branch of the brachial plexus of Chauveau, who also recognises in it the representative of the nerve of Wrisberg.

² *Jour. Anat.*, July 1887.

following condition of parts will be found :—The axillary interval is very narrow, in one place the pectoralis major and latissimus actually touch ; lying in this narrow interval, and under cover of the adjacent part of the pectoralis major to a considerable extent, we find the pectoralis quartus,¹ while the panniculus covers the interval and its contained muscle completely. Converging towards the axilla, its dorsal fibres are rather closely united to the axillary border of the latissimus ; the most anterior of these pass forwards to be inserted into the humerus, the more posterior fibres cross the axilla, *passing obliquely* over the pectoralis quartus, and end partly by blending with the axillary border of the great pectoral, partly by passing over this border and becoming lost on the outer surface of the muscle ; indeed, the panniculus in this animal might be described as a muscular sheet passing from the outer surface of the latissimus dorsi obliquely, or almost transversely across the axilla to the outer surface of the great pectoral, and shutting off the axilla and its contents from all superficial structures, its fibres crossing those of the pectoralis quartus very obliquely. Here, again, we have a condition of parts which seems to preclude all possibility of the pectoralis quartus having been derived from the panniculus ; so it would appear most probable that Professor Owen's theory is the correct one—that the pectoralis quartus is a segmented portion of the great pectoral muscle.

As regards the achselbogen, I shall begin by discussing those views which appear least probable, and most easily examined.

First, Mr Galton's idea that the achselbogen corresponds to the pectoralis quartus. This view has been disposed of in connection with the pectoralis quartus.

Mr J. B. Perrin's view that the slip in question is an aborted variety of dorso-epitrochlearis, is scarcely more tenable. The dorso-epitrochlearis agrees with the achselbogen in none of our criteria except in origin—both spring from the latissimus at the junction of muscle and tendon ; in position and insertion there is absolutely no resemblance, and in nerve-supply there is the widest difference, the dorso-epitrochlearis, as pointed out when speaking of the pectoralis quartus, is supplied by a branch

¹ Where the pectoral and latissimus meet, the quartus is *completely overlapped by them*.

of the musculo-spinal nerve, the achselbogen is normally supplied by a branch of the internal anterior thoracic, as will be shown later on. Further, Mr J. T. Wilson¹ records two cases of achselbogen in the human subject, and in each of these a dorso-epitrochlearis was present as a separate and distinct muscle. Evidently we can find no grounds for considering achselbogen and dorso-epitrochlearis the same; and we pass on to the consideration of the other views.

Of the two remaining theories regarding the nature of the achselbogen,—Professor Humphry's, that it is due to an imperfect segmentation of pectoral from latissimus, and Sir William Turner's, that it is panniculus,—each seems so probable, and when tested by the different criteria gives such proof in support of its claims for adoption, that we can decide which is probably the correct one only after a careful and thorough investigation of both. If the achselbogen were really formed, in the manner suggested by Professor Humphry, by the imperfect separation of the latissimus from the pectoral muscles, if it were simply a connecting band left after the incomplete splitting of one layer of muscle into two parts, we should expect to find the connecting slip passing from the *margin* of one division very obliquely across the interval to the margin of the other. Apparently the achselbogen fulfils these conditions; at first sight it seems to spring from the axillary edge of the latissimus, where its fibres look as if they were perfectly continuous with the fibres of that muscle, indeed, it would seem as if a band of the substance of the latissimus had been bent across the axilla to the opposite border, where it blends with the pectoralis major; still, if we examine the attachment of the achselbogen to the latissimus, or what we may call the origin of the slip, we will find that in the majority of cases the connection between the two is not what it seems to be upon casual inspection. I have dissected with great care a few of these attachments, and I have found that the achselbogen instead of springing from the very edge of the muscles, does not actually do so; traced backwards it passes over the margin, crossing the fibres of the latissimus *obliquely*, and becoming attached to its outer surface some distance from the edge. Secondly, the muscular fibres of the latissimus *seem*

¹ *Jour. Anat.*, January 1888.

to pass uninterruptedly into those of the achselbogen. On dissection, I have found this not to be so; the little muscle followed backwards over the margin of the latissimus passes into a thin flat aponeurotic band, and the other end of this band blends with the muscular substance on the back of the latissimus. (Luschka¹ considers that this little aponeurotic band described above is always present when the achselbogen springs from the muscular part of the latissimus; Testut² is not convinced of its constant presence.) Then we have found (1) that the fibres of the achselbogen cross obliquely those of the latissimus dorsi; (2) that they do not spring from the margin of the muscle; and (3) that they are not continued into the fibres of the latissimus, but end in an aponeurotic band which is attached to the outer surface of that muscle. All these facts militate against Professor Humphry's view, and, as I shall point out afterwards, favour the claims of the panniculus. In position and insertion the achselbogen fulfils the conditions laid down above, as those that should be present in a muscle formed according to the imperfect segmentation theory. Let us now apply our last criterion, nerve-supply: if the achselbogen be derived from the imperfect separation of the pectoralis major and latissimus, it ought to participate in the nature of one of these muscles, as well as in that of the other,—consequently its nerve-supply ought to be double, it should be derived from the nerve to its pectoral, as well as from that to its dorsal parent. Do we find such a nerve-supply for the achselbogen? I may answer at once—no. But before proceeding any further it would be well to decide what is the normal nerve-supply of the muscle in question.

In the January number of the *Journal of Anatomy* for 1888 Mr J. T. Wilson, in an interesting account of the dissection of two cases of achselbogen, records the nerve-supply. On one side he found it came from the intercosto-humeral, the lateral cutaneous of the third intercostal piercing the muscle; on the other side, it was innervated by a branch from the nerve of Wrisberg, which in this case sprang from the inner cord of the brachial plexus by a trunk common to itself and the internal anterior thoracic.

To Professor Cunningham I am indebted for the notes of two cases read by him before the British Association in Montreal,

¹ Testut on *Muscular Anomalies*, p. 111.

² *Ibid.*

1884; in both the nerve came from the internal anterior thoracic, and the intercosto-humeral pierced the muscle without supplying it.

Karl Bardeleben¹ records a case where the nerve came from the internal thoracic also.

Dr Brooks has kindly sent me notes of two cases which he met,—in one the nerve came from the internal thoracic, in the other, from the loop of communication between the two thoracics; the intercosto-humeral pierced the muscle in one of these cases.

I myself have twice found the nerve,—once it arose from the inner cord of the brachial plexus, between the internal thoracic and the nerve of Wrisberg; in the other case, it came from the internal thoracic after it had received the usual communication from the external, but the fibres were traced into the trunk of the internal above the connection; an extremely minute twig of the intercosto-humeral entered and was lost in the muscle, this I considered simply a sensory filament.

Thus we find that, out of nine cases, in five the nerve to the achselbogen came directly from the internal anterior thoracic, in one case from the loop between the inner and outer anterior thoracics, in one from the inner cord close to the origin of the internal thoracic, and in one from the nerve of Wrisberg, which arose by a trunk common to it and the internal anterior thoracic; the nerve in these three latter cases, although differing superficially from the condition in the first five, is probably fundamentally the same in origin; so that out of the nine we have only one which really differs from the others, namely, that of Mr Wilson, in which the nerve came from the intercosto-humeral; this exception, I think, we must consider an abnormality. I have never found upon direct stimulation of the nerve that the intercosto-humeral contained motor fibres.² From the foregoing I may safely, I think, draw the conclusion that the achselbogen is normally supplied by the internal anterior thoracic nerve. And further, as far as I can find, there has not been recorded a case in which the subscapular nerve supplied a branch to the achselbogen; such a branch I have looked for with great care, but always with negative results.

¹ *Jen. Zeitschrift für Naturwissenschaft*, Bd. xv. N. F. viii., 1881.

² In animals.

Then in nerve-supply we see that the achselbogen differs from the condition which we should expect to find if that muscle were really derived from the imperfect separation of the latissimus dorsi from the pectoralis major; if such were its true nature it should have not only a nerve from the internal thoracic, but also one from the long subscapular, indeed we might expect to find this latter the chief nerve of the muscle, seeing that it is most closely connected with the latissimus. The fact that I could find no branch from the subscapular to the achselbogen first shook my belief in the theory of Professor Humphry, which I held as most probable when I began this inquiry; the result was that I turned to the view of Sir William Turner, with what fruits I shall now proceed to show.

Professor Turner considered the achselbogen—as well as several other muscular slips, which he described in the first volume of the *Journal of Anatomy*—a derivative of the panniculus. My investigation of the subject leads me to the same conclusion, namely, that the achselbogen is a derivative of the anterior and dorsal portion of the humeral panniculus.

In animals we generally find the humeral panniculus as a thin sheet converging from the lateral region of the trunk towards the axilla, where it is inserted in connection with the pectoralis major, on its deep surface as a rule; its ventral fibres overlie the great pectoral, the dorsal fibres cover the latissimus, and the intermediate fibres lie against the lateral thoracic wall. From the anterior dorsal fibres I believe the achselbogen is derived; coming from the back, they sweep over the latissimus dorsi across its axillary margin, and then run obliquely over the axillary interval to their insertion in connection with the pectoralis major. From this it will be seen that in position and insertion this portion of the panniculus agrees exactly with the achselbogen, and indeed in a carefully dissected humeral panniculus one is struck immediately by the resemblance which its anterior border bears to an axillary muscular arch—notably in position. Then, tested by two criteria, position and insertion, panniculus and achselbogen correspond. Now, as regards origin, or what we have decided to consider origin, namely, attachment to the latissimus dorsi, is it possible that a portion of the panniculus could come to be so intimately connected to the

latissimus as the achselbogen commonly is? The answer is—Yes. If we examine the panniculus in several animals we shall find every step in the change from panniculus passing freely over the axillary border of the latissimus to the condition of the achselbogen, where the union between the two is so intimate that one seems to be merely a slip of the other. In most animals, *e.g.*, Rabbit, Horse, Macaque, &c., the dorsal portion of panniculus passes as a somewhat thickened border freely over the latissimus to its insertion, as described above. Next, in the Cat we find it rather closely adherent to the latissimus at its margin. In the *Cynocephalus anubis*, Mr Champneys,¹ speaking of the panniculus, says:—"It gave a few fibres to the latissimus dorsi after having previously received a few from it." Here, evidently, are two steps towards the condition at the origin of the achselbogen. Dr A. MacCormick,² after describing the pectoralis quartus in *Phalangista vulpina*, says:—"The lower part of its tendon is joined by a slip from the latissimus dorsi, and the slip contains fibres from the panniculus carnosus as well as fibres from the latissimus itself." Lastly, Mr Galton³ writes:—In the Wombat "a slip is moreover sent from the interior part of the latissimus dorsi over the axillary vessels and nerves to join the highest part of the tendon of the pectoralis major." This, he says, "may belong, however, to the panniculus carnosus; but this latter is so closely blent with the anterior edge of the latissimus dorsi that it is difficult to satisfactorily see the nature of the muscle in question." Here we have the panniculus and latissimus so closely united at the axillary border that they cannot be distinguished from one another—a close approach to the condition of the achselbogen at its origin from the latissimus; indeed, another step brings us to the achselbogen itself. This apparently close connection between latissimus and achselbogen is on the surface the greatest obstacle to Sir William Turner's view that the latter muscle is panniculus; so close is the union between them that it is almost impossible to

¹ *Jour. Anat.*, vol. vi. p. 177. He remarks that the connection between the panniculus and latissimus seems to be represented occasionally (Henle and Wood) in man by a connection between latissimus dorsi and pectoralis major, *i.e.*, by achselbogen.

² *Jour. Anat.*, Oct. 1886.

³ *Trans. Linn. Soc.*, vol. xxi.

get rid of the idea that the achselbogen is some way or another derived from the latissimus dorsi. But the obstacle is not insurmountable if we remember, as I have already pointed out, that the fibres of the achselbogen are not directly continuous with those of the latissimus, but are simply attached to the back of that muscle through the medium of an aponeurotic band; and, secondly, that the panniculus, as shown above, may become so closely blended with the latissimus that the two are practically inseparable.

A few other points in connection with the blending of the two muscles. Professor Humphry, in his *Observations in Myology*,¹ describes the panniculus as a superficial stratum of the ventral muscle segmented off from the "external oblique layer." He further tells us that this segmentation is often incomplete, and that the two layers are more or less blended at places; when this is so, the junction of the segmented with the unsegmented portion of the superficial layer is effected through the medium of fibrous septa—such a blending and such a junction we apparently have at the origin of the achselbogen from the latissimus dorsi. We may consider the achselbogen as panniculus which is segmented off from the deeper parts in the region of the axilla, unsegmented over the latissimus, and the union between the two parts is effected through the medium of the little aponeurotic band which I have already described as attaching the achselbogen to the back of the latissimus. This condition of the achselbogen agrees in every detail with Professor Humphry's observations about the panniculus above quoted.

Again, Professor Turner² describes an axillary muscular arch receiving a number of scattered fasciculi which arose from the superficial aspect of the fascia over the serratus magnus, and along with these were other fasciculi which were attached to the fascia forming the floor of the axilla. Here apparently we have the remains not only of the anterior dorsal portion of the panniculus—as in the ordinary achselbogen—but also a trace of the portion which covers the lateral aspect of the thorax. Even more of the sheet has been found by the same anatomist³ in a

¹ Pp. 109 and 129.

² *Jour. Anat.*, vol. i. p. 252, footnote.

³ *Ibid.*

well-marked bundle springing from the pectoral fascia turning round the axillary border of the pectoralis major and forming the achselbogen. And a somewhat similar slip is described by Professor Humphry.¹

I need go no further to show that the panniculus, not only in position and insertion, but also in its connection with the latissimus dorsi, can present a condition exactly similar to that of the achselbogen, and three of our criteria are satisfied. Next let us apply the test of nerve-supply to the panniculus and achselbogen.

The achselbogen, I have shown above, is normally supplied by the internal anterior thoracic nerve; the nerve-supply of the panniculus certainly seems very different, in animals it is supplied by a nerve known as the "lateral cutaneous nerve of the thorax," or the "subcutaneous thoracic branch of the brachial plexus." We shall examine this nerve. In his able paper on the limb plexuses in mammals, Dr A. M. Paterson² describes it in the Porcupine, which is taken as a typical mammal. Here part of the ventral division of the eighth cervical joins a branch of the first thoracic to form the lateral cutaneous nerve of the thorax, which runs down the side of the trunk under cover of the panniculus, supplying it and the skin of the axilla, and communicating with the lateral cutaneous branches of the intercostal nerves. In this lateral cutaneous of the thorax Dr Paterson recognises the homologue of the nerve of Wrisberg—which is otherwise generally absent in mammals—and he bases this opinion on its origin, on its distribution to the skin of the axilla, and on its communicating with lateral cutaneous branches of the intercostal nerves. Dr Paterson's idea of the homology of the nerve under consideration is supported by Mr J. T. Wilson in the *Journal of Anatomy* for January 1888. Chauveau³ also states that the lesser internal cutaneous (nerve of Wrisberg) is represented in quadruped by the subcutaneous thoracic (lateral cutaneous of thorax).

That the lateral cutaneous of the thorax which supplies the panniculus represents the nerve of Wrisberg to a large extent

¹ *Observations in Myology*, p. 131, footnote.

² *Jour. Anat.*, July 1887.

³ Chauveau's *Compar. Anat.* by Fleming, p. 768.



is probably correct, but at the same time I believe that it represents not only the nerve of Wrisberg, but, in addition, part, or sometimes the whole, of another nerve.

If Dr Paterson's view be true, then the panniculus is supplied by the nerve of Wrisberg, the achselbogen by the internal anterior thoracic, and, tested by the most important of the four criteria, Professor Turner's theory fails. But, on the other hand, if we can show that the lateral cutaneous of the thorax contains within it other fibres than those representing the nerve of Wrisberg, then there is still hope for the view that achselbogen is panniculus. To aid us in arriving at the true nature of the nerve, we shall examine it in a series of animals.

I have already pointed out that the pectoralis quartus is supplied by a branch of the internal anterior thoracic nerve, and I think I am correct in saying that such is its nerve-supply in every animal that has an internal thoracic (considering the fact that the quartus is undoubtedly a member of the pectoral group, it would naturally be supplied by a pectoral or anterior thoracic nerve). Now, in the Opposum, Kangaroo, and Wallaby¹ the pectoralis quartus is supplied by the lateral cutaneous of the thorax; the internal thoracic is absent, and the external sends the branch of communication which usually passes between the two thoracics to the lateral cutaneous of the thorax instead. These are significant facts. Why does the lateral cutaneous supply the pectoralis quartus? Why does it receive the communication from the external thoracic? The answer must be, because it contains embodied within it the internal anterior thoracic in addition to the representative of the nerve of Wrisberg. This is the only conclusion we can arrive at after a consideration of the above facts; and as we examine a series of animals we shall find other grounds for this conclusion, we shall find every step between the condition in marsupials where the two nerves are united into one, and the condition which obtains in man where the two are distinct and separate.

In the Rabbit I found a nerve springing from the trunk formed by the last cervical and first thoracic, this nerve divided into internal thoracic and lateral cutaneous of thorax; in other words, the two nerves arose by a common trunk.

¹ Mr Wilson, *loc. cit.*

In the Cat, which, like other Carnivora, is said to want a pectoralis minor, I met the following arrangement:—Two thoracic nerves arose from the trunk formed by the seventh cervical alone, these were both distributed to the great pectoral; the posterior or inner of the two sent a communicating filament to the next branch described, this branch arose by two roots from eighth cervical and first dorsal. These roots united received the communication referred to above from the thoracic, and then divided into two parts; one of these went to the pectoralis quartus, the other was the lateral cutaneous of the thorax.

In the Dog I found the lateral cutaneous formed by two roots of nearly equal size; one came from the posterior (inner) cord of the brachial plexus, the other from the internal anterior thoracic. In this animal the constitution of the lateral cutaneous is evident; we see plainly that it is made up largely of fibres of the internal thoracic,—these are probably the motor fibres for the panniculus,—and in addition of fibres derived from the posterior cord (inner), which may probably be sensory only, and represent the nerve of Wrisberg. So far we have in the marsupials described, the two nerves completely united: in the Rabbit the two united for a short distance, in the Dog the internal thoracic furnishing half the fibres of the lateral cutaneous, and a somewhat similar condition in the Cat. From this it is clear that the two nerves—internal thoracic and lateral cutaneous—are most intimately connected both in origin and distribution; and, further, that the lateral cutaneous probably always contains a large number of fibres from the internal thoracic trunk. Moreover, it appears that fibres may sometimes come with apparent indifference from either one or the other of these nerves. For instance, in the Hedge-Hog I have seen the internal thoracic and the lateral cutaneous arise side by side from the posterior or inner cord of the plexus; the internal thoracic was distributed to the pectoralis minor as usual, the lateral cutaneous to the panniculus. The latter nerve was very large, and a short distance from its origin it gave a small branch to the pectoralis minor, that is, a pectoral branch arises from the lateral cutaneous. I have found the opposite condition in the Horse; in this animal a large nerve arose from the trunk formed by the first and second thoracic nerves, this divided into the lateral cutaneous

(subcutaneous thoracic) and large branches to the so-called posterior deep pectoral; from one of these branches to the pectoral came a nerve which was distributed to the panniculus; on stimulation I found that this branch, as well as the lateral cutaneous, contained motor fibres for the panniculus. Here we find a pectoral nerve giving off a branch which should have come from the lateral cutaneous. These two cases afford further evidence of the close connection existing between the two nerves.

But in the Macaque Monkey I have found the link required to connect the condition of the lateral cutaneous of the thorax in the mammals described above with that found in man. In this animal the internal anterior thoracic, which arose from the inner cord of the brachial plexus, gave off a branch which divided into two parts; one of these went directly to the pectoralis quartus, the other was joined by a branch of the intercosto-humeral, and then divided immediately into the nerve to the panniculus and a nerve which corresponded in distribution to the nerve of Wrisburg in the human subject.¹ Here at last we have the divorce of the two constituents of the lateral cutaneous from one another, and the key to the true nerve-supply of the panniculus. Let us examine the arrangement more closely. A branch from the intercosto-humeral—*ergo*, from the second dorsal nerve—joins with a comparatively large branch of the internal thoracic. Now, if they remained joined, and ran down to the panniculus, they would have formed a lateral cutaneous exactly similar to the same nerve in the Rabbit (previously described); and we would describe the condition by saying that the lateral cutaneous and the internal thoracic arose by a common trunk, that lower down the lateral cutaneous communicated with the intercosto-humeral—like the lateral cutaneous in other animals—and that it was then distributed to the panniculus. The same terms will apply to the lateral cutaneous in the Rabbit. But in the Macaque, instead of remaining one single nerve, a division takes place—a separation of the two parts which would form a lateral cutaneous similar to that of the Rabbit and other mammals—and as a result we have a nerve

¹ This condition is not constant in the Macaque, but I have found it three or four times.

of Wrisberg corresponding in distribution to the human one, and a nerve to the panniculus. And this nerve of Wrisberg is not only similar in distribution to the nerve of the same name in man, but is similar, to a certain extent, in origin too, for most of its fibres are derived from the intercosto-humeral branch of the second dorsal nerve; and it seems very probable that the nerve of Wrisberg derives some of its fibres from the second dorsal, through the communication usually found connecting it with the first, the majority of the fibres coming from the first dorsal. Owen says the nerve of Wrisberg is formed by fibres derived from the eighth cervical and first dorsal, but I have never been able to trace fibres of the cervical nerve into it.¹ On the other hand, I have found it receiving a considerable contribution from the second dorsal—indeed, the alternation in size found between this nerve of Wrisberg and the intercosto-humeral prepares one for the fact that the second dorsal usually contributes to the formation of the lesser internal cutaneous. (Further, in this connection I have found the nerve of Wrisberg absent as a branch of the brachial plexus in man, and its place completely filled by a lateral cutaneous branch of the first intercostal, which arose from the trunk soon after the nerve came out from the intervertebral canal, but pierced the intercostals in the axillary line. Here the representative of the nerve of Wrisberg could not possibly have received fibres from the eighth cervical, and the condition of the nerves, when taken with other considerations, leads one to the idea that the nerve of Wrisberg is the lateral cutaneous branch of the first intercostal nerve to a large extent.²) Now, we will naturally inquire, where does the nerve to the panniculus in the Macaque get its motor fibres? It must be from one or both of those nerves which, by their union in this animal, give rise to the nerve to the panniculus and the nerve corresponding to the lesser internal cutaneous. These

¹ Mr Herringham (*Proc. Roy. Soc.*, p. 431, Nov. 30, 1886) says the nerve of Wrisberg was formed by the first dorsal (in which he includes the communicating twig from the second) in nineteen out of twenty cases examined by him; in one case a filament came from the eighth cervical.

² According to Owen (*Comp. Anat.*) the lateral cutaneous branch of the third intercostal, and according to Swan (*Comp. Anat.*, "Nerv. System") the lateral cutaneous of the second intercostal corresponds in the Fox to the nerve of Wrisberg.

are the intercosto-humeral and the internal anterior thoracic. I have already stated that, by stimulation of the intercosto-humeral (in several animals), I could never make the panniculus contract; further, in most animals the intercosto-humeral pierces the panniculus without giving any fibres to it—a relation similar to that in Professor Cunningham's, and one of Dr Brooks', cases of achselbogen recorded above; and lastly, the lateral branches of the intercostal nerves are cutaneous or sensory. Considering these facts, we must infer that the intercosto-humeral does not supply the motor fibres to the panniculus, and we arrive at the conclusion that it is supplied by the internal anterior thoracic. This nerve is, I believe, the true motor nerve of the panniculus.

Dr Paterson's opinion that the lateral cutaneous nerve of the thorax is the homologue of the nerve of Wrisberg seems strange, in view of the facts that the nerve of Wrisberg is entirely a sensory nerve and the lateral cutaneous is chiefly motor, for its sensory fibres are very few, and seem to be derived chiefly from communications with the lateral cutaneous nerves of the thorax. An examination of the nerve in the marsupials mentioned in the Dog and the Macaque point directly to the fact that it is a compound nerve, formed by the union of the homologue of the nerve of Wrisberg with part of the internal thoracic, or with the whole of that nerve in some marsupials.¹ I may add that the internal thoracic and the nerve of Wrisberg, in the human subject, occasionally spring by a common trunk from the inner cord of the plexus; and, even when they spring separately, if the plexus be teased out, it will often be found that they unite within the cord to form a distinct bundle, so that, even in man, the close connection between the two nerves is apparent.

Returning, then, after a long digression, to the achselbogen, we found that the panniculus agreed with it in origin, position, and insertion. We are now able to add that it agrees with it in nerve-supply too, and all our criteria are satisfied. So we may conclude that Professor Sir William Turner's theory, tested by the criteria proposed, is the true one, namely, that the

¹ And, seeing that the nerve is chiefly motor, the "nerve to the panniculus" would seem a more appropriate name than the "lateral cutaneous of the thorax," unless we substitute musculo-cutaneous for the term cutaneous alone.

achselbogen is derived from the humeral part of the panniculus carnosus.

In the foregoing I think I have adduced sufficient proof to show (1) that the pectoralis quartus is a segmented portion of the great pectoral; (2) that the achselbogen is a derivative of the panniculus; (3) that the pectoralis quartus is supplied by the internal anterior thoracic nerve; (4) that the achselbogen is supplied by the same nerve; and lastly, that the lateral cutaneous nerve of the thorax is the homologue of the nerve of Wrisberg, associated with more or less of the internal thoracic; or, perhaps, it might be more correctly put, that the lateral cutaneous of the thorax is the homologue of (*a*) the nerve of Wrisberg, associated with (*b*) another nerve which usually arises, and is closely connected, with the internal thoracic. This second nerve (*b*) I consider a distinct element, which increases or diminishes with the panniculus, and which is absent in man, as a rule, but is occasionally represented as the nerve of the achselbogen.